

# **ATTACHMENT 1**

**Project specification for construction requirements for  
drilled shafts and CSL test requirements  
FP-96, 1996**

ARROYO SECO ROAD  
CA PFH 129-1(1)

## Arroyo-Seco Bridges, CA PFH 129-1(1)

### 565.05 Drilled Shafts.

**(a) Excavation.** Delete the last sentence of the first paragraph and substitute the following:

Drilled shafts shall be constructed so that the center at the top of the shaft is within the following tolerances:

Shaft Diameter (m)	Tolerance (mm)
0.610	75
0.915	90
1.220	100
1.525 or larger	150

Perform frequent checks on the plumbness, alignment, and dimensions of the drilled shaft during drilling or excavation of the shaft. Correction of any deviation exceeding the allowable tolerances shall be performed using an approved procedure.

**(c) Casings.** Add the following:

Provide temporary casings from the ground line to the depth where the casing is firmly socketed into the rock. Stepped casing shall not be allowed.

Add the following subsections:

**565.07A Integrity Testing.** Perform integrity testing using the crosshole sonic logging (CSL) procedure to verify the drilled shaft structural integrity and to determine the extent and location of defects. These defects include: internal voids, perimeter integrity, transverse cracks, soil intrusions, and weak concrete or grout.

**(a) Personnel requirements for CSL.**

- (1) Qualifications of CSL Consultant.** Use a consultant experienced in CSL testing. An engineer/technician with at least one (1) year experience in CSL testing shall perform the field testing. A licensed professional engineer with at least three (3) years of experience in CSL testing and interpretation shall interpret the recorded measurements. Provide

personnel resumes of job experience and appropriate documentation including names, addresses, and telephone numbers of organizations or associations that can verify the information. Approval of the CSL testing consultant is required before drilled shaft work begins. Allow 4 weeks for the Government to approve/disapprove the CSL testing consultant.

- (2) **Assistance to the testing consultant.** Provide labor as required to adequately perform the required tests.

**(b) Equipment requirements for CSL.** Provide CSL equipment meeting the following minimum requirements:

- (1) Ultrasonic source and receiver probes capable of producing records with good signal amplitude and energy through uniform, good quality concrete. The probes shall be of a diameter and have cabling such that they descend freely through an 52.5mm inside diameter access pipe for the full depth of the drilled shafts shown on the plans.
- (2) Capability to record the depth of the probes with a measurement wheel or other suitable measuring device.
- (3) Measurements made with a microprocessor based system for analog-digital conversion and recording of data, display of individual records, and analysis of receiver responses and printing of logs.
- (4) Appropriate filter/amplification of data and cable systems.
- (5) Triggering of the recording system synchronized with the ultrasonic pulse.
- (6) An independent, stable, 110V, 55-60 Hz, AC power supply.

**(c) CSL test requirements.** Perform integrity tests on each production drilled shaft. Test the drilled shaft after two (2) days and within forty-five (45) days of concrete placement. Prior to testing, provide the drilled shaft lengths, tube lengths and positions, and drilled shaft construction dates to the crosshole sonic logging consultant.

**(d) CSL access pipe preparation.** Provide nominal 50 mm diameter standard weight steel tubes (ASA B36.10, inside diameter = 52.5 mm) for each drilled shaft as shown in the plans. Use pipes that have a round, regular internal diameter free of defects and obstructions, including any at pipe joints, in order to permit the free, unobstructed passage of source and receiver probes. Use pipes that are watertight and free from corrosion with clean internal and external faces to ensure passage of the probes and to ensure a good bond between the concrete and the pipes. Do not use duct tape or similar wrapping material to seal joints. Do not use stiffening devices such as mandrels in the access pipes during concrete placement.

Fit the pipes with a watertight shoe on the bottom and a removable cap on the top. Secure the pipes to the interior of the reinforcement cage. Install the pipes in a regular, symmetric pattern such that each pipe is spaced the maximum distance possible from each adjacent pipe. The pipes shall be as near to parallel as possible. Extend the pipes from 150 mm above the drilled shaft bottoms to at least 1 meter above the drilled shaft tops, and at least 0.6 meters but not more than 1.5 meters above the ground surface. Make any joints required to achieve full length pipes watertight. Do not damage the pipes during reinforcement installation operations in the drilled shaft hole.

After placement of the reinforcement cage, fill the access pipes with clean water within one hour of concrete placement. Cap the pipe tops to prevent debris from entering the access pipes. Do not apply excess torque, hammering, or other stresses which could break the bond between the pipe and concrete when removing caps or plugs from the pipes.

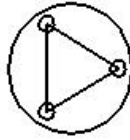
The drilled shaft contractor shall be responsible for due care and good workmanship in installing pipes such that the testing equipment will pass through the entire length of the pipe. Ensure that the access pipes are plumb and verify that unobstructed passage of the probes is achievable before the tester arrives. If the probe will not pass through the entire length of the pipe, provide replacement access holes by core drilling. Locate cored holes about 150 mm inside the reinforcement. Log core holes and include descriptions of any inclusions or voids.

After all integrity testing inspection has been completed, place grout tubes extending to the bottom of the test pipe and fill all holes and test pipes in drilled shafts with a grout meeting the requirements of 725.22(f).

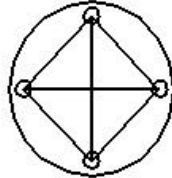
**(e) CSL procedure.** Perform logging between adjacent perimeter access pipes and diagonally between access pipes within the drilled shaft (see Test Schematic). Carry out the tests with the source and receiver probes in the same horizontal plane unless test results indicate potential defects, in which case the questionable zone shall be further evaluated with angled tests (source and receiver vertically offset in the tubes).

Remove the cable slack between the probes and depth wheel or other measuring device to provide accurate depth measurements on the logs. Pull the probes simultaneously, taking crosshole sonic measurements at intervals of 50 mm or less from the bottom to the top of the drilled shaft. Report defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals. Additional tests such as the offset elevation crosshole sonic logging testing may be required to further evaluate the extent of such defects. If debonding between the access pipe and the concrete is indicated by the CSL results, an alternative test method will be required to determine the integrity of the concrete in the debonded region.

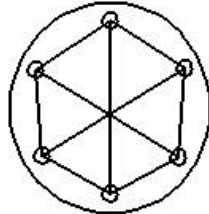
All costs associated with the alternative test method will be borne by the Contractor.



Shaft diameter  $\leq 1000$  mm  
Three tubes = 3 Tests



$1000 \text{ mm} < \text{Shaft diameter} \leq 1550$  mm  
Four tubes = 6 Tests



$1550 \text{ mm} < \text{Shaft diameter} \leq 2500$  mm  
Six tubes = 9 Tests

### TEST SCHEMATIC

**(f) CSL results.** Present the results of the CSL in a report within ten (10) days of completion of testing. This report shall include:

- (1) Project identification
- (2) Structural member tested with descriptive and graphic location
- (3) Date testing performed
- (4) Name of CSL tester and reviewer
- (5) Equipment type used and calibration records
- (6) Analyses to evaluate the integrity of the concrete including a log of the initial pulse arrival times versus depth and the pulse amplitude/energy versus depth between the source and the receiver for every pair of tubes tested.
- (7) A CSL results summary table which includes the following information: drilled shaft tested; average compression velocity (m/s); test length (m); date tested; age of concrete (days); figure number reference for the applicable CSL logs; Concrete Condition Rating (see below) ; listing of any anomalous concrete zones including the affected tube pairs, depth (location) of anomalous zone, and percent reduction.

### Concrete Condition Rating Criteria

Rating	Indicative CSL Results
Good (G)	No signal distortion or decrease in signal velocity of 10 percent or less
Questionable (Q)	Minor signal distortion and a lower signal amplitude with a decrease in signal velocity between 10 percent and 20 percent. Results indicative of minor contamination or intrusion and/or questionable quality concrete.
Poor/Defect (P/D)	Severe signal distortion and much lower signal amplitude with a decrease in signal velocity of 20 percent or more. Results indicative of water slurry contamination or soil intrusion and/or poor quality concrete.
No Signal (NS)	No signal was received. Highly probable that a soil intrusion or other severe defect has absorbed the signal (assumes good bonding at the tube-concrete interface). If the measurement is from near the shaft top, debonding is suspect.
Water (W)	A measure signal velocity of nominally 1,450 m/s to 1,525 m/s. This is indicative of a water intrusion or of a water filled gravel intrusion with few or no fines present.

A preliminary report shall be provided to the CO on site as soon as testing is completed. Reports not including the items listed above will be considered unacceptable. The CSL report shall be submitted directly to the CO from the CSL consultant for an independent review and comment at least 5 days prior to any further construction on the tested member. The Government may request an independent review of the test data and conclusions.

**565.07B Correction of Unacceptable Drilled Shaft.** If integrity testing indicates the presence of voids or zones of unconsolidated concrete in the drilled shaft or if the Contracting Officer determines that construction defects may have occurred, core drill or otherwise expose the concrete. If a defect that compromises the integrity or performance of the drilled shaft is confirmed, the Contractor shall bear all costs involved with the coring and pressure grouting of the core hole. If no such defects exist, the Government will pay for coring and pressure grouting of the core holes under the applicable bid item.

When a drilled shaft is determined to be unacceptable, submit a plan for remedial action to the Government for approval. Modifications to the drilled shaft or load transfer mechanisms required by the remedial action shall be designed by a registered professional engineer. Include drawings stamped by a registered professional engineer for all foundation elements affected. Do not begin remedial action work until the remedial action plan has been approved by the Contracting Officer. Furnish materials and work necessary to correct defective drilled shafts.

**565.08 Acceptance.** Amend the section sentence to read:

Construction of drilled shafts will be evaluated under Subsections 106.02, 106.04, 565.07A, and 565.07B.

## Measurement

### **565.09** Add the following:

Measure Coring/Pressure Grouting by the meter for coring and grouting where no defects exist. Do not measure Coring/Pressure Grouting for payment when defects are found. Do not measure Coring/Pressure Grouting for grouting of the grout tubes after integrity testing. Measure temporary casing from the ground line to the depth the casing is installed. Measure Crosshole Sonic Logging (one time for each drilled shaft) by the each.